Inter-annual Variations of Air Mass Transport to the Arctic

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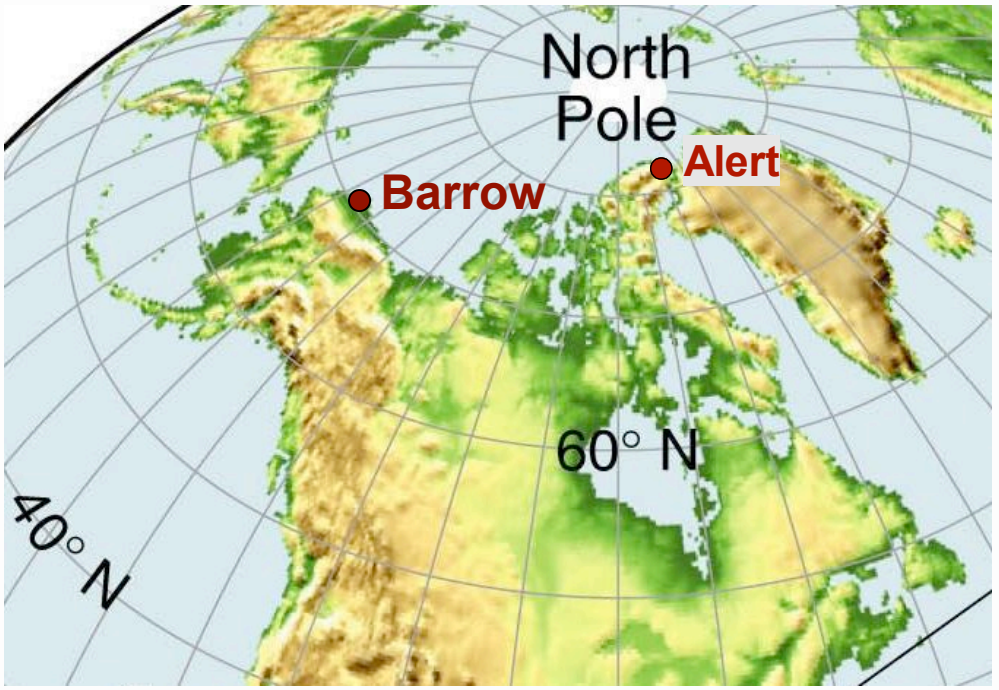
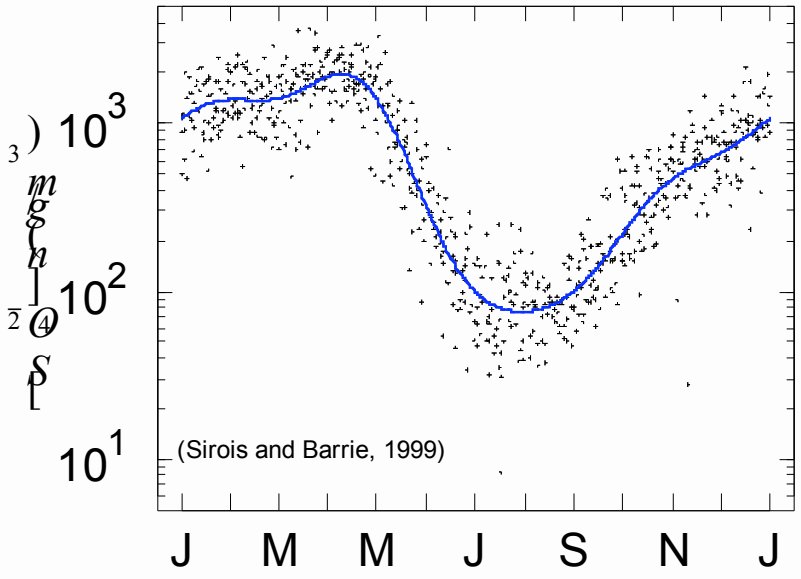
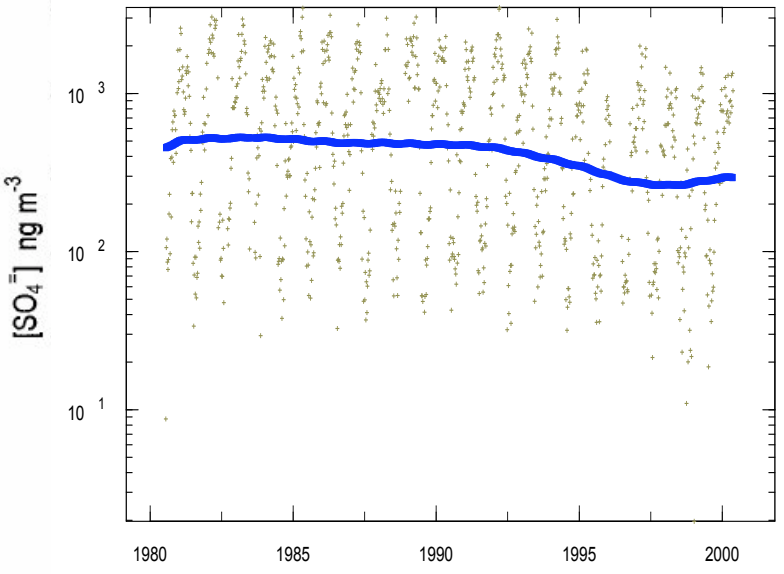


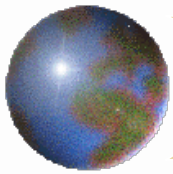
January 8, 2007

Observed Temporal Variation for Sulphate

Measured aerosol sulphate at Alert (1980--1995)







How to model the seasonal changes and trends?

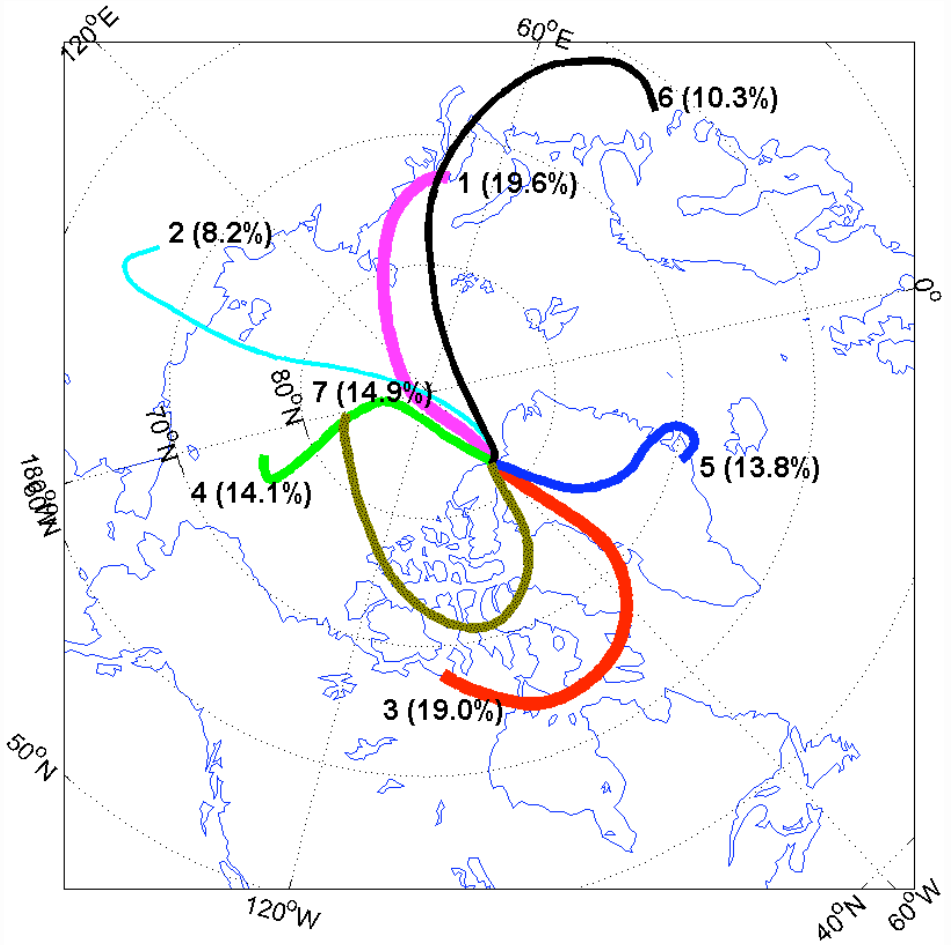
- Emissions surrounding the Arctic.
- Removal patterns – e.g. precipitation changes
- Transport patterns.

Trajectory Calculations

- Trajectory Model:
  - HYSPLIT4 (NOAA Air Resources Laboratory)
- Trajectory duration: 10-day backward
- Arriving at Alert (Barrow)
  - 82.31 N, 62.31 W (71.32 N, 156.6 W)
  - 1000 m above sea level
  - ***12*** times a day for ***1989-2000*** (***1988-1998***)
- Clustering Technique
  - Based on Dorling's Algorithm (Dorling et al., 1992)
  - Modified to handle a large number of trajectories

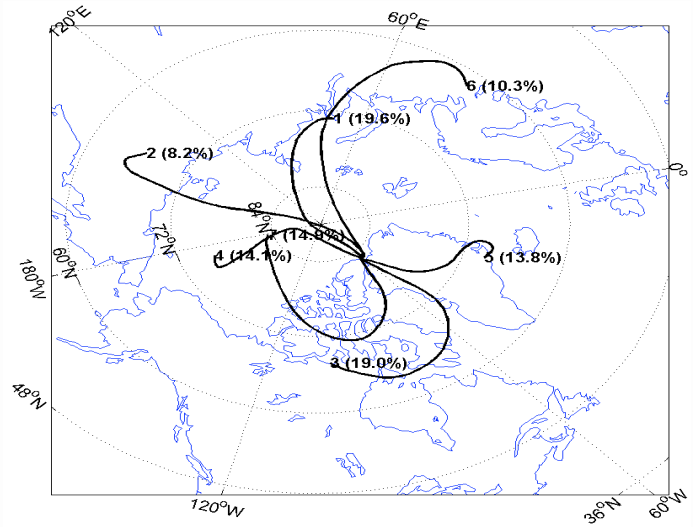
Wintertime Transport Patterns for 1981-2000

- 2480 trajectories in total;
- Best grouped into 7 clusters;
- Clusters 1, 2, and 6 account for ~40% of the overall air mass transport;
- The interannual variability of transport patterns were obtained by counting the number of trajectories from each year.

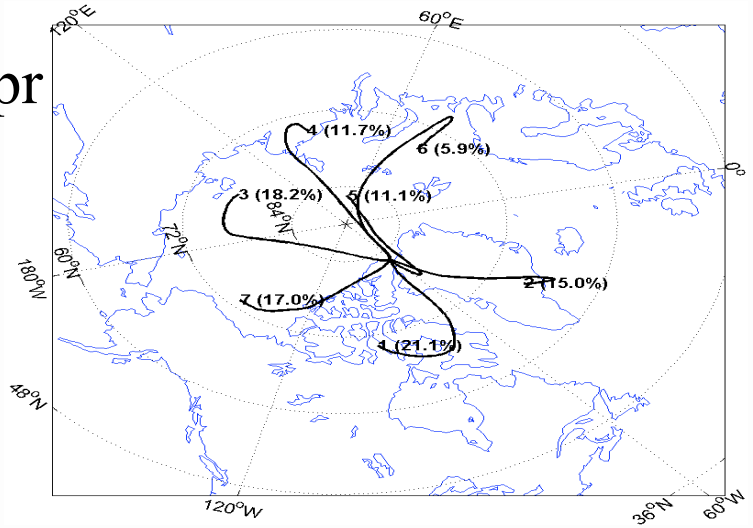


Cluster-mean plots for the four mid-season

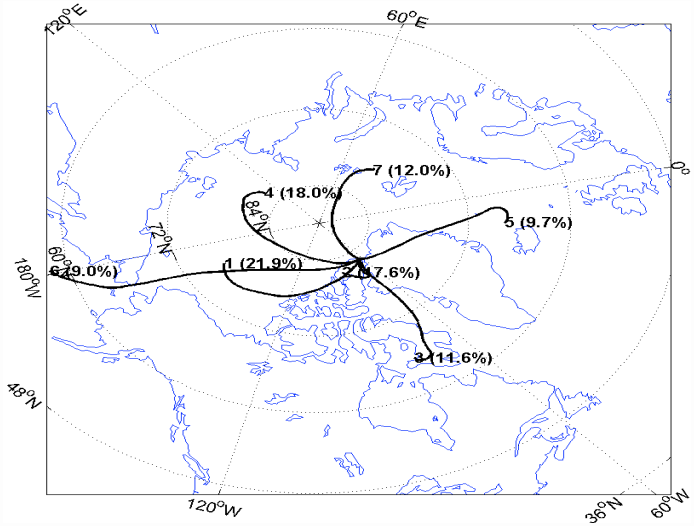
Jan



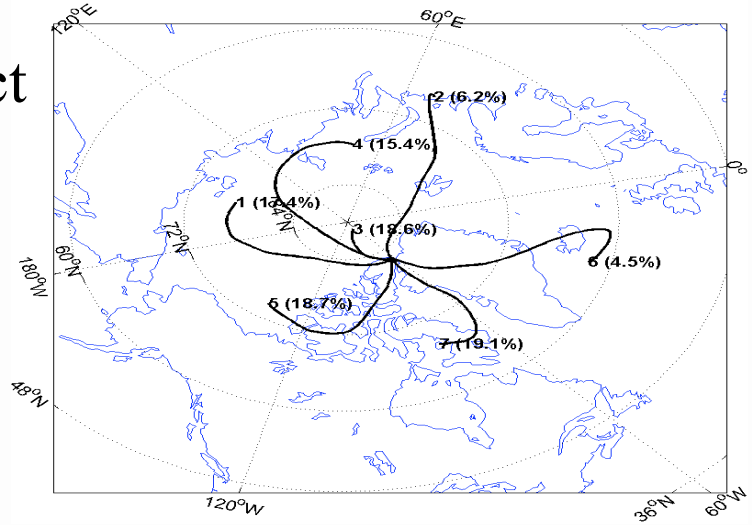
Apr



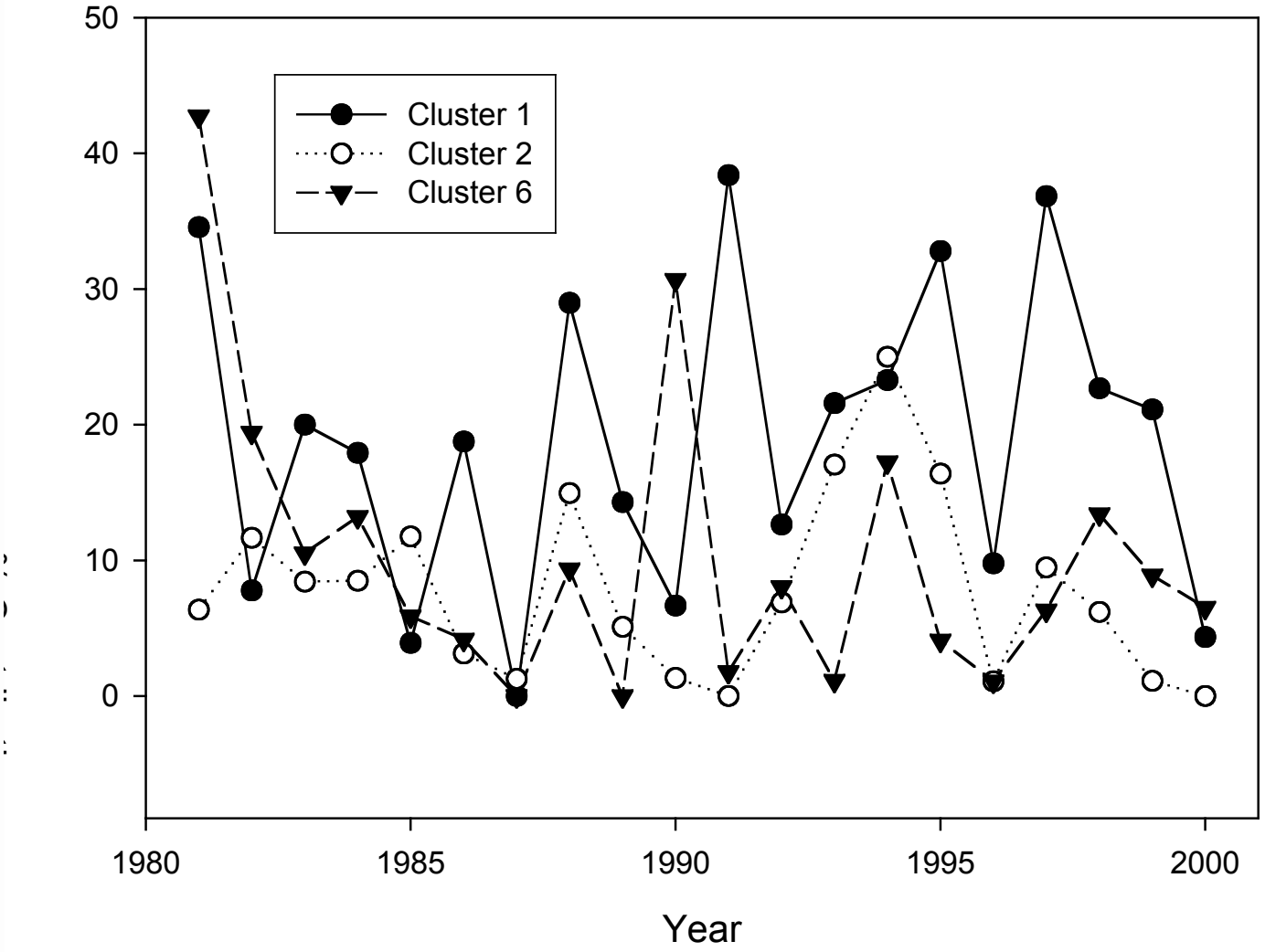
Jul



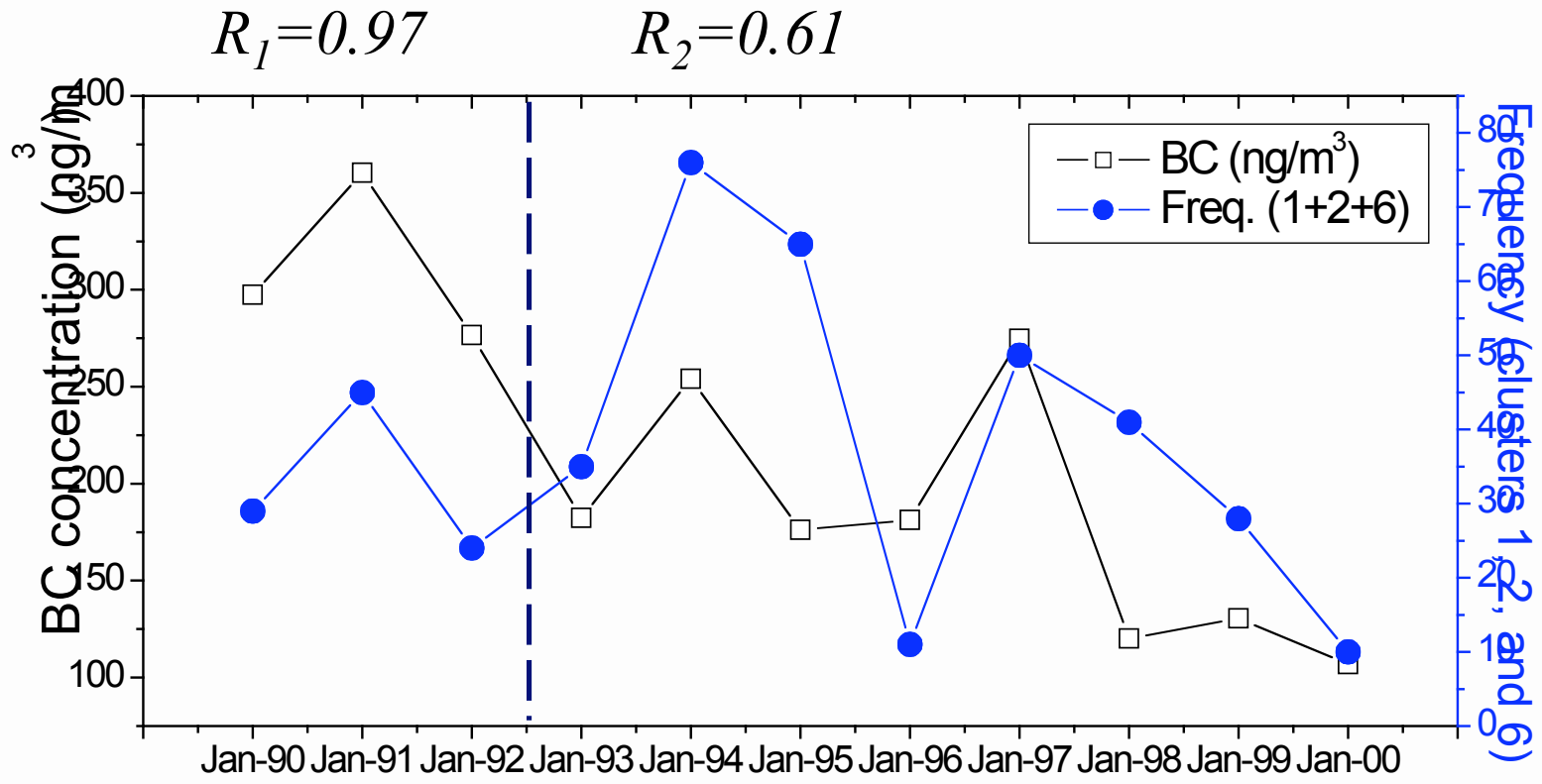
Oct



Inter-annual Variations for Jan.

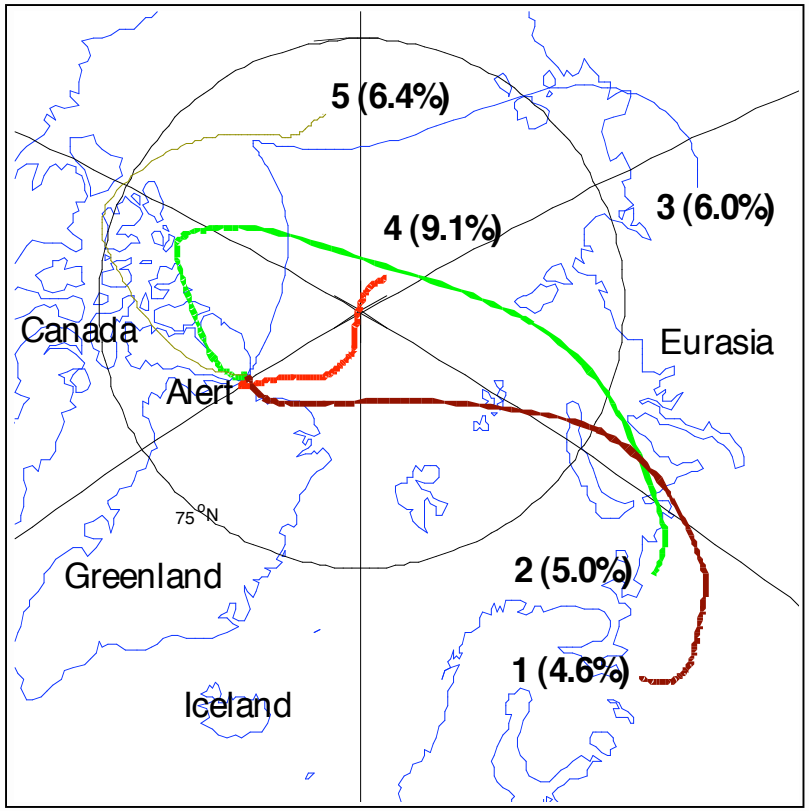


Correlation between Transport Frequency and Black Carbon Concentration



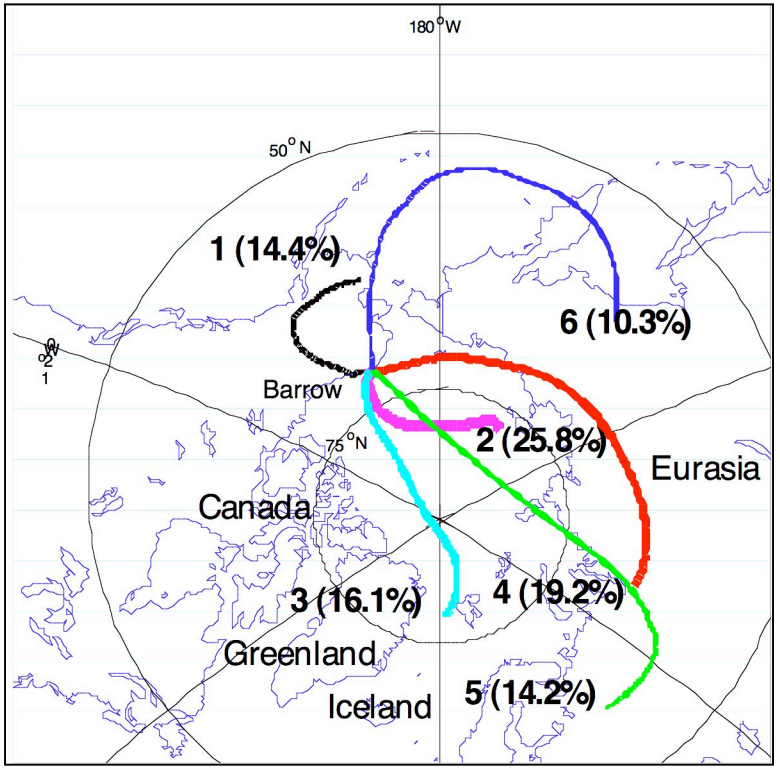
Transport Frequency ~ NAO/AO Indices at Alert

Correlation (R)	AO	NAO
Cluster 1	-0.545	-0.169
Cluster 2	-0.249	-0.301
Cluster 3	-0.485	-0.655
Cluster 4	0.429	0.287
Cluster 5	0.570	0.070
Clusters 1+2+3	-0.677	-0.626
Clusters 4+5	0.697	0.271

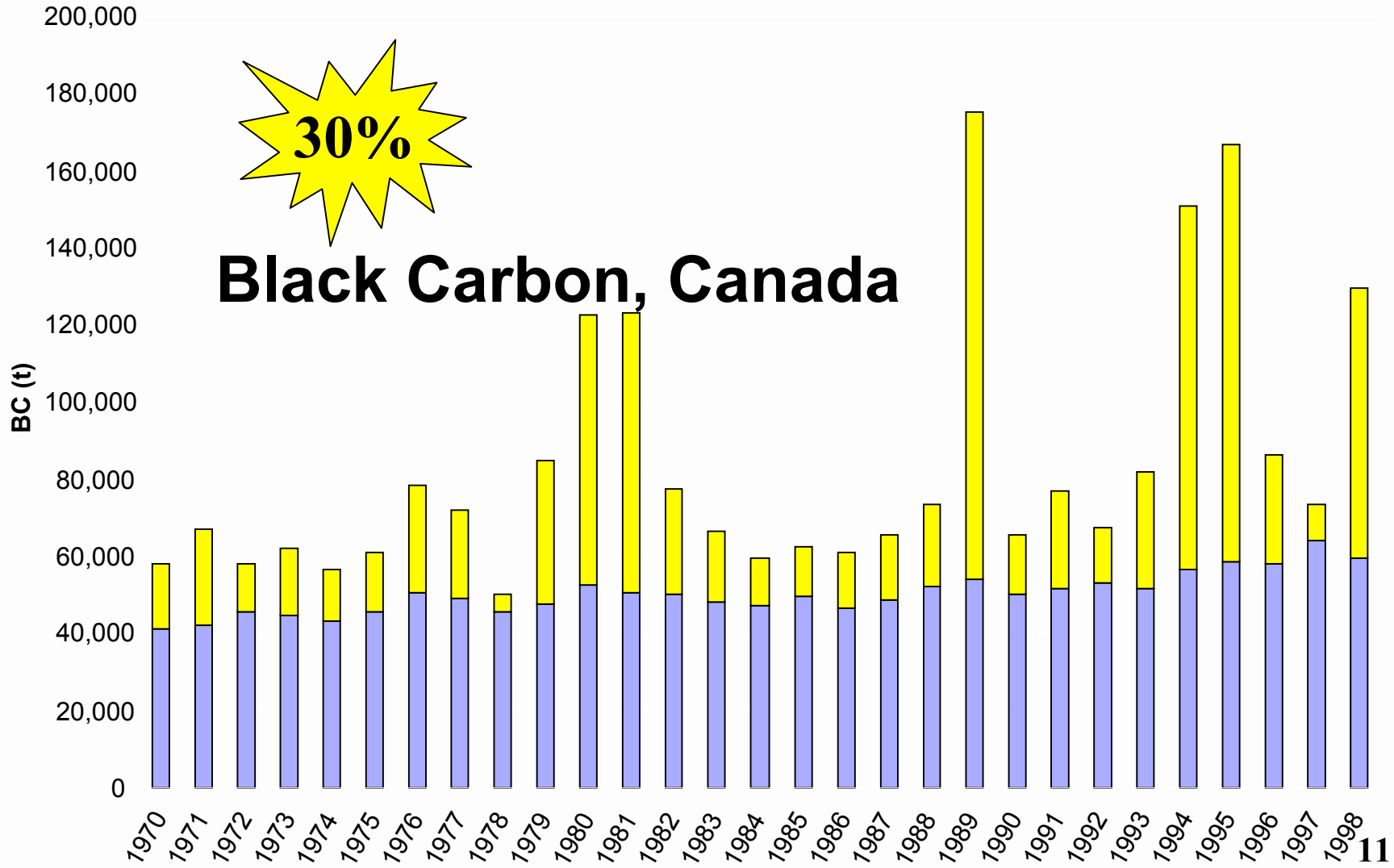


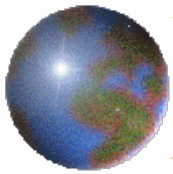
Transport Frequency ~ NAO/AO Indices at Barrow

Correlation (R)	AO	NAO
Cluster 1	-0.718	-0.410
Cluster 2	-0.751	-0.906
Cluster 3	-0.482	0.110
Cluster 4	0.411	-0.900
Cluster 5	0.682	0.725
Cluster 6	0.307	0.433
Clusters 5+6	0.825	0.942



Variations in BC Emissions





Questions:

- Which is the dominant factor in modeling the observed spatial and temporal distributions of pollutants?
  - Transport variations
  - Removal processes
  - Emissions